

# iop tsunami lifeboat

*by* Aulia Windyandari

---

**Submission date:** 30-Jan-2019 07:07AM (UTC+0700)

**Submission ID:** 1070311280

**File name:** kki\_2018\_IOP\_Conf.\_Ser.\_3A\_Earth\_Environ.\_Sci.\_135\_012006\_1.pdf (633.99K)

**Word count:** 4213

**Character count:** 20097

**PAPER • OPEN ACCESS**

## The Evaluation of Cone Capsule as an Alternative Hull form for Portable Tsunami Lifeboat to Support Evacuation System in the Coastal Regions and Small Islands

14

To cite this article: Ahmad Fauzan Zakki *et al* 2018 *IOP Conf. Ser.: Earth Environ. Sci.* **135** 012006

16

View the [article online](#) for updates and enhancements.

**Related content**

22

- [Analysis of community tsunami evacuation](#)

34

- [An overview](#)

Y Yunarto and A M Sari

- [Implementation Of Haversine Formula And Best First Search Method In Searching Of Tsunami Evacuation Route](#)

Anisya and Ganda Yoga Swara

22

- [Spatial Analysis of Traffic and Routing](#)

36

- [Methods for Tsunami Evacuation](#)

A Fakhurrozi and A M Sari

## The Evaluation of Cone Capsule as an Alternative Hull form for Portable Tsunami Lifeboat to Support Evacuation System in the Coastal Regions and Small Islands

Ahmad Fauzan Zakki<sup>1</sup>, Suharto<sup>2</sup>, Aulia Windyandari<sup>2</sup>

<sup>1</sup>Naval Architecture Department, Engineering Faculty, Diponegoro University, Semarang, Indonesia

<sup>2</sup>Industrial Technology Department, Vocational School, Diponegoro University, Semarang, Indonesia

Email : ahmadfzakki@undip.ac.id

**Abstract.** Several attempts have been made to reduce the risk of tsunami disasters such as the development of early warning systems, evacuation procedures training, coastal protection and coastal spatial planning. Although many efforts to mitigate the impact of the tsunami in Indonesia was made, no one has developed a portable disaster rescue vehicle/shelter as well as a lifeboat on ships and offshore building, which is always available when a disaster occurs. The aim of the paper is to evaluate the performance of cone capsule shaped hull form that would be used for the portable tsunami lifeboat. The investigation of the boat resistance, intact stability, and seakeeping characteristics was made. The numerical analysis results indicate that the cone capsule is reliable as an alternative hull form for the portable tsunami lifeboat.

### 1. Introduction

Tsunamis are waves that propagate in all directions and occur because of an impulsive disturbance on the seabed. The impulsive disorders occur because of changes in the shape of the geological structure of the seabed vertically and in a short time. The changes were caused by three main sources, namely tectonic earthquakes, volcanic eruptions, or a landslide that occurred on the seabed. Based on the three sources, the main cause of the tsunami in Indonesia is a tectonic earthquake.

Indonesia is a country prone to tsunamis, especially the coastal areas which deal directly with the meeting of the Eurasian Plate, the Indo-Australian and Pacific, among others, the western part of Sumatra Island, southern part of Java, Nusa Tenggara, the northern part of Papua, Sulawesi and Maluku, and the eastern part of the Borneo Island, [1].

Tsunami in Aceh on December 26, 2004, killed about a quarter million lives around the Indian Ocean region. History tsunami disaster within the last twenty years shows that at least ten tsunami disaster in Indonesia (see Figure 1), [1]. Nine tsunamis of them are destructive tsunami and caused casualties and material, the tsunami in Flores on December 12, 1992 which claimed more than 2000 lives, the tsunami in Banyuwangi, East Java (1994), Biak (1996), Maluku (1998), Banggai, Sulawesi Utara (2000), Ransiki, West Papua (2002), a large tsunami in Aceh (December 2004), the tsunami in Nias (2005), West Java (2006), Bengkulu (2007), and Mentawai (2010), [1]. Impact damage caused by the tsunami has destroyed residential areas and the number of casualties.

Based on data from the Meteorology and Geophysics, it shows that arrival time of the tsunami that occurred in Indonesia, generally between 10-60 minutes, [2]. It is determined that tsunamis occurring in



Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

Published under licence by IOP Publishing Ltd

Indonesia are a local tsunami. Very short tsunami arrival time will influence the evacuation process and time. The evacuation process should be done rapidly and be supported by the ease of access to the safety equipment.

Accordingly, the application of lifeboat technology which is used on ships and the offshore building is developed as a solution in providing protection and tsunami rescue equipment (rescue disaster-shelter). The design of portable tsunami lifeboat is proposed by adding the cone capsule as an alternative hull form of the portable tsunami lifeboat. Therefore, the main focus of this paper is to evaluate the performance of cone capsule shaped hull form that would be used for the portable tsunami boat. The investigation of the boat resistance, intact stability, and seakeeping characteristics is made. The results of this study are expected able to provide a positive contribution to the development of technology disaster mitigation in the coastal regions and small islands.



**Figure 1.** The distribution of tectonic earthquake and tsunami damage between years 1991-2010

## 2. Literature Reviews

In the study of tsunami lifeboat technology development, the majority of reviewed articles were related to freefall lifeboat technologies, collision and water entry phenomena. It is due to the tsunami lifeboat usability and operational conditions similar to freefall lifeboat that is experiencing an excessive impact load/slamming during water entry phase.

E. Schreck, [3], conducted a study on the development of lifeboat launching simulation in storm conditions. In this simulation, it is considered some variables of detail geometry, waves, and the wind. Coupled simulation of fluid flow and flow induced motion of rigid bodies are used to solve the problems of simulation. The results showed that good agreement between simulation and experimental results.

D. M. Bae, H. S. Kim, A. F. Zakki, [4], conducted a study on the structural response simulations of freefall lifeboat for 25 passengers in the event of impact with the water. The use of explicit methods on Arbitrary Lagrangian Eulerian ALE Fluid-Structure Interaction FSI analysis is used to solve this problem. In another paper Zakki, A. F., [5] conduct a study on the assessment of impact load on freefall lifeboat for 25 person launching system using HYBRID III dummy model. Response to motion of Hybrid III Dummy Model was assessed to determine the mechanism of injury occurrence and the effectiveness of the occupant's restraint system in freefall lifeboat.

D. M. Bae, A. F. Zakki, H. S. Kim, J. G. Kim, [6], perform numerical studies on the estimated response of acceleration in freefall lifeboat with FSI Analysis using LS-DYNA Code. The results of this study show that the estimation of the response acceleration has a good agreement between the experimental results with simulation analysis.

D. M. Bae, A. F. Zakki, [7], in another study describes a comparison between the method of multi-material ALE (MMALE) and single material ALE (SMALE) for estimation of the response acceleration



in freefall lifeboat. The results showed that MMALE requires computing time is longer than SMALE. However, the use SMALE also be accepted at the design stage of freefall lifeboat development.

H. Luo, H. Wang, C. G. Soares, [8], conduct numerical and experimental studies of elastic response and hydrodynamic collision when a wedge with stiffened panel free fall. In this study, Wagner Uncoupled Method by combining theory and the finite element method is used to analyze slamming 3D structure. Matched asymptotic theory developed to predict the movement and slamming pressure on the free-drop rigid body. Slamming pressures are then added to the finite element models to predict the transient response of the structure. Comparison between the numerical and experimental results shows good agreement.

Olav Aagaard, [9], conducted a study on the hydroelastic analysis on flexible wedges. The simulation model was developed to analyze water entry of the flexible wedges. Effect of viscosity and compressibility is considered in the investigation. The results showed a good agreement between the simulation and experiment.

Espen Larsen, [10], conducted a study on the impact load on Circular Cylinder. 2D simulations using the STAR-CCM+ has been carried out at a constant speed and freefall cylinder. The results showed that there was good agreement between the simulation and experiment.

M. Shito, [11], conducted numerical and experimental studies on the tsunami for the design of coastal and offshore structures. Numerical simulation of tsunami propagation, wave impact load and hydraulic experimental techniques to reduce the wavelength of a tsunami was studied in depth in this study. The study shows that it takes more detailed hydraulic experiments to examine every aspect of the tsunami wave loads.

A. F. Zakki, A. Windyarti, D. M. Bae, [12], conducted the development of new type free-fall lifeboat using FSI Analysis. The results of the study provide the parameters for numerical analysis of the acceleration response induced by slamming load during water entry phase in the launching process.

A. R. Prabowo, et al., [13], examined the effects of the selected collision parameter values on the characteristics of collision energy in several ship collision scenarios. The angle position between the two objects during the impact process significantly contributed to the damage pattern on the side hull. The final results also indicated that the cross-section of the target point's location influenced the observed parameters.

D. M. Bae, et al., [14], investigated the several parameters used in the numerical simulation of a collision between two ships. The element model study performed indicates that the Belytschko-Tsay element formulation should be recommended for use in virtual experiments. It is recommended that the real value of the friction coefficient for materials involved is applied in simulations.

D. Chrismianto, et. al., [15], the use of optimization analysis and computational fluid dynamics was applied to the development of the submarine hull form. The parametric model of submarine hull form was proposed using the cubic bezier curve and curve-plane intersection method. The results show that the submarine hull shape might be generated with some variation of the input parameters.

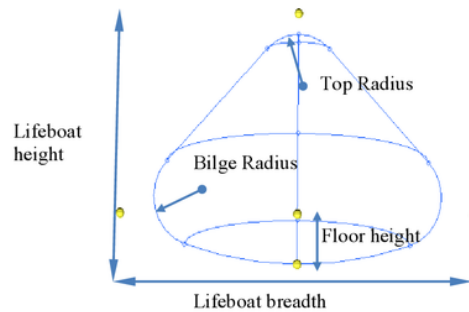
### 3. The Principal Dimension of Cone Capsule Shaped Hullform

Generally, in freefall lifeboat design planning, there are several requirements provided by the buyer (owner and mission requirements) such as the height of the offshore platform, service speed ( $V_s$ ), and occupants capacity, in addition to the requirements related to safety, comfort, and beauty. The mission requirements became important information that will be used as a basis by the lifeboat planners to determine the lifeboat's principal dimensions are compatible regarding technical and economical.

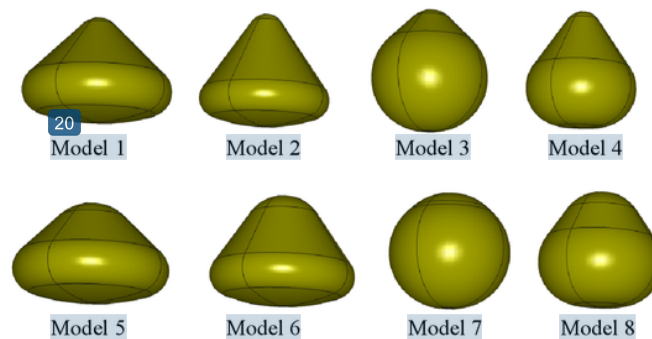
In determining the principal dimension of the tsunami lifeboat, it is determined that the design configurations of the lifeboat dimension have a fixed draught of 500mm, the lifeboat heights of 2500 mm and 3500 mm, and the lifeboat breadth/length of 4000 mm. Furthermore, the estimated displacement of the design configurations was used as a reference for the cone capsule shaped tsunami lifeboat dimension.

Since the principal dimensions of the tsunami lifeboat were made, furthermore the shape of the cone capsule shaped hull form is determined by the configuration of geometry parameters, see **Table 1**. The

radius of bilge, the ratio of the height of cone and radius of the cone and the depth of floor was considered for the shape configuration of cone capsule shaped hull form see **Figure 2**. The detail shapes of cone capsule shaped hull form for tsunami lifeboat are presented in **Figure 3**.



**Figure 2.** The geometry parameters of cone capsule



**Figure 3.** The detailed shape of the configurations of cone capsule shaped hull form

#### 4. Results and discussion

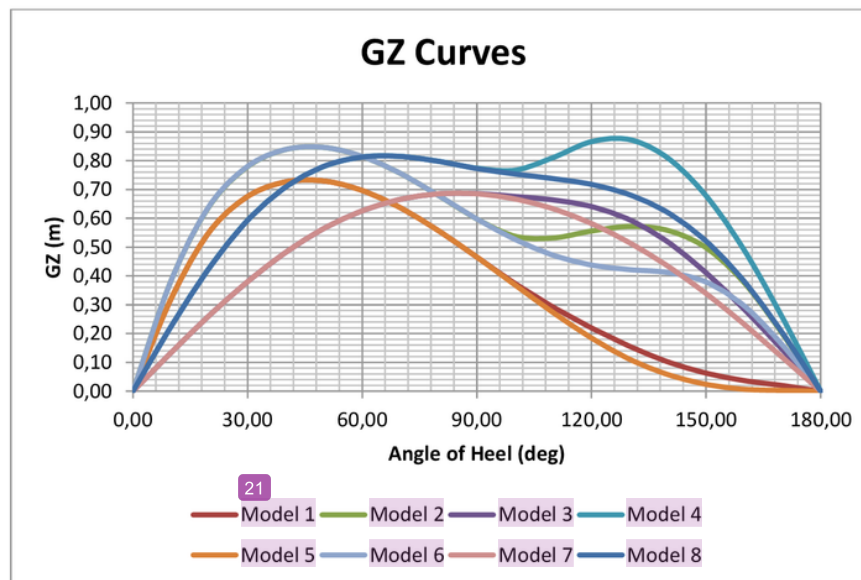
##### 4.1. Intact Stability Performances

The stability curves of the proposed cone capsule shaped hull form are presented in **Figure 4**. Comparison of stability curves of the design configurations of the cone capsule shaped hull form in each of loading conditions has been plotted jointly. Regarding the stability curves calculated for each loading conditions, all conditions have positive GZ. It is indicated that the positive intact stability was conducted by **5** tsunami lifeboat hull form.

All the case studies fulfilled all applicable IMO stability criteria; see **Table 1**. In the case of area  $0^\circ$  to  $40^\circ$ , the model 6 has the largest area than others. It is indicated that the model 6 have a better righting moment during the heel interval from  $0^\circ$  to  $40^\circ$ . The model 6 also shows better performance in the heel angle  $30^\circ$  to  $40^\circ$ . In the criterion of GZ at  $30^\circ$ , the model 6 and model 2 have the same GZ length of 0.85m which is the largest GZ length amongst others. Accordingly, the numerical results show that the model 6 has an intact stability performance better than the other models.

**Table 1.** The design configurations of cone capsule shaped hull form for tsunami lifeboat.

| Hullform Design | Radius of top<br>[mm] | Radius of bilge<br>[mm] | Draught<br>[mm] | Lifeboat Height<br>[mm] |
|-----------------|-----------------------|-------------------------|-----------------|-------------------------|
| Model 1         | 500                   | 500                     | 500             | 2500                    |
| Model 2         | 500                   | 500                     | 500             | 3500                    |
| Model 3         | 500                   | 1000                    | 500             | 2500                    |
| Model 4         | 500                   | 1000                    | 500             | 3500                    |
| Model 5         | 1000                  | 500                     | 500             | 2500                    |
| Model 6         | 1000                  | 500                     | 500             | 3500                    |
| Model 7         | 1000                  | 1000                    | 500             | 2500                    |
| Model 8         | 1000                  | 1000                    | 500             | 3500                    |

**Figure 4.** The stability curves of the configuration of cone capsule shaped hull form

### 3.2. The Seakeeping Performances

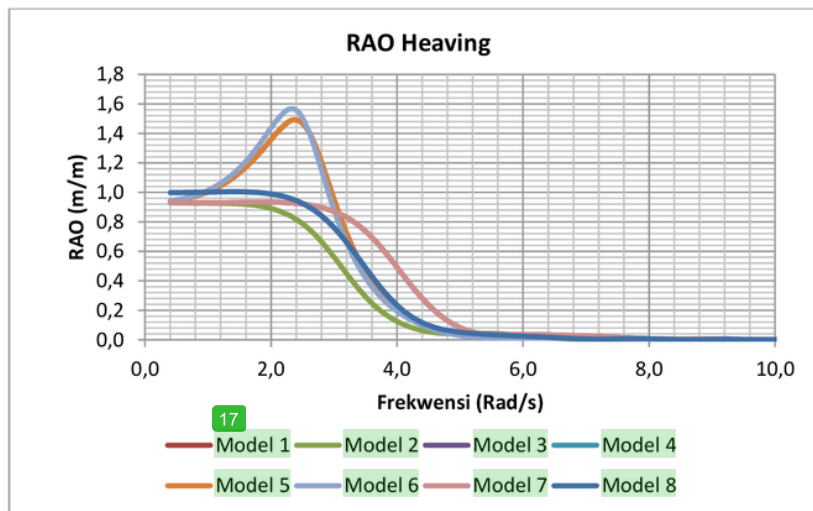
In ship design, it is important to pre-determine the behavior of the ship or floating structure when it is subjected to waves. It can be calculated, found through physical model testing and ultimately measured on board the vessel. The calculations can be performed analytically for simple shapes like rectangular barges, but need to be calculated by a computer for any realistically shaped ship. The results of some of these calculations or model tests are transfer functions called Response Amplitude Operators (RAO)

Seakeeping analysis is performed using the wave and wind characteristic of the Java Sea which is defined as the high, rough and phenomenal conditions. The environment conditions were made as an equivalent environment for the tsunami incidence. The rough conditions have the sea state of 5 and the significant wave height of 4 m while the high conditions have a sea state of 7 with the significant wave height of 9 m. The most severe condition was defined as phenomenal conditions have the sea state of 9 and the significant wave height of 15 m. Considering the Java Sea characteristics, the ITTC spectra was chosen for the seakeeping analysis. Calculations were made at 0 knots for the lifeboat speed, Head Sea and the ITTC wave spectrum with significant wave height of the rough, hard and phenomenal conditions.

**Table 2.** Tsunami lifeboat intact stability and IMO criteria

| Criteria                               | Required    | Cone Capsule Shaped Tsunami Lifeboat |       |       |       |       |       |       |       |
|--|-------------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|
|  |             | Model                                |       |       |       |       |       |       |       |
|  |             | 1                                    | 2     | 3     | 4     | 5     | 6     | 7     | 8     |
| 10                                     |             |                                      |       |       |       |       |       |       |       |
| Area 0° to 30°                         | 3,15 m.deg  | 12.33                                | 14.42 | 5.89  | 9.57  | 12.33 | 14.43 | 5.89  | 9.57  |
| Area 0° to 40°, or Downflooding point  | 5,16 m.deg  | 19.40                                | 22.56 | 10.22 | 16.12 | 19.40 | 22.57 | 10.21 | 16.12 |
| Area 30° to 40°, or Downflooding point | 1,719 m.deg | 7.07                                 | 8.14  | 4.33  | 6.55  | 7.07  | 8.15  | 4.33  | 6.55  |
| GZ at 30°, or greater                  | 0,2 m       | 0.734                                | 0.85  | 0.687 | 0.82  | 0.734 | 0.85  | 0.69  | 0.82  |
| Angle of GZ max                        | 25 deg      | 45.5                                 | 46.4  | 85.5  | 126.4 | 45.5  | 46.4  | 85    | 65.9  |
| GM                                     | 0,15 m      | 1.93                                 | 2.33  | 0.78  | 1.31  | 1.93  | 2.34  | 0.78  | 1.31  |

Seakeeping analysis is calculated by using commercial software with frequency domain strip theory. The result of the analysis is Response Amplitude Operator (RAO). RAO is the transfer function expressing the relation between wave spectrums in response to movement of the vessel (ship response spectrum). The response characteristics of the movement of the proposed hull form can be seen from RAO. On the RAO diagram, the magnitude of the response sensitivity of the lifeboat against the excitation force caused by ocean waves might be seen. The RAO on the heave motion of the developed tsunami lifeboat hull form in the Head Sea might be seen in **Figure 5**. Furthermore, the motion response of the tsunami lifeboat was shown in **Table 2**.

**Figure 5.** RAO of cone capsule shaped models heave in head sea

Based on the results obtained from the calculation (**Figure 5** and **Table 2**), it appears that the heave motion response of the entire lifeboat hull forms was similar. The amplitude of the heave of the lifeboat hull forms is 0.93m-1m, 2.15m-2.25m and 3.49m-3.75m for the rough, high and phenomenal conditions, respectively. The smallest heave motion amplitudes are shown by model 2. Otherwise, the model 4 and model 8 have shown the largest amplitude of the heave motion as high as 3.75m. Accordingly, it is indicated that the high cone with the relatively flat bottom able to reduce the heave motion response. The large bottom area has a damping effect to the heave motion of the lifeboat. Furthermore, the heave



velocity and acceleration response appeared in the range of 0.79-1.70m/s and 0.93-1.44m/s<sup>2</sup>, respectively. The minimum heave velocity and acceleration response were also made by the model 2. On the other hand, the model 8 has the maximum heave velocity, and the model 6 has the maximum heave acceleration.

In the case of pitch motion, it appears that the minimum pitch motion response was made by the model 2. The amplitude of the pitch motion of the lifeboat hull forms is 6.12°-8.90°, 6.93°-9.57° and 7.32°-9.90° for the rough, high and phenomenal conditions, respectively. The smallest amplitude of pitch motion was made by the model 2 of 6.12° in the rough conditions. Otherwise, the maximum amplitude is shown by the model 6 of 9.90° in the phenomenal sea conditions. The pitch velocity and accelerations of the lifeboat hull forms were obtained as 0.19rad/s -0.30rad/s and 0.41rad/s<sup>2</sup>-0.80rad/s<sup>2</sup>, respectively. The minimum pitch velocity and acceleration are shown by the model 2. Accordingly, it may be concluded that the model 2 have the best seakeeping performance than the other hull forms.

**Table 3.** Tsunami lifeboat motion behavior in the rough, high and phenomenal environment

| Significant 4 m (Sea State 5 - Rough)    |         |         |         |         |         |         |         |         |
|--|---------|---------|---------|---------|---------|---------|---------|---------|
|  | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 |
| Heave motion (m)                         | 0.99    | 0.93    | 0.93    | 1.00    | 0.99    | 1.00    | 0.93    | 1.00    |
| Pitch motion (deg)                       | 8.73    | 6.12    | 7.02    | 6.58    | 8.73    | 8.90    | 7.02    | 6.58    |
| Heave velocity (m/s)                     | 0.91    | 0.79    | 0.81    | 0.86    | 0.91    | 0.93    | 0.81    | 0.86    |
| Pitch velocity (rad/s)                   | 0.29    | 0.19    | 0.27    | 0.23    | 0.29    | 0.29    | 0.27    | 0.23    |
| Heave acceleration (m/s <sup>2</sup> )   | 1.24    | 0.93    | 1.03    | 1.04    | 1.24    | 1.27    | 1.03    | 1.04    |
| Pitch acceleration (rad/s <sup>2</sup> ) | 0.68    | 0.47    | 0.80    | 0.60    | 0.68    | 0.66    | 0.80    | 0.60    |

| Significant 9 m (Sea State 7 - High)     |         |         |         |         |         |         |         |         |
|--|---------|---------|---------|---------|---------|---------|---------|---------|
|  | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 |
| Heave motion (m)                         | 2.15    | 2.09    | 2.10    | 2.25    | 2.15    | 2.16    | 2.10    | 2.25    |
| Pitch motion (deg)                       | 9.40    | 6.93    | 7.71    | 7.34    | 9.40    | 9.57    | 7.71    | 7.34    |
| Heave velocity (m/s)                     | 1.31    | 1.21    | 1.23    | 1.31    | 1.31    | 1.33    | 1.23    | 1.31    |
| Pitch velocity (rad/s)                   | 0.30    | 0.20    | 0.26    | 0.23    | 0.30    | 0.30    | 0.26    | 0.23    |
| Heave acceleration (m/s <sup>2</sup> )   | 1.36    | 1.06    | 1.15    | 1.18    | 1.36    | 1.38    | 1.15    | 1.18    |
| Pitch acceleration (rad/s <sup>2</sup> ) | 0.68    | 0.47    | 0.74    | 0.59    | 0.68    | 0.66    | 0.74    | 0.59    |

| Significant 15 m (Sea State 9 - Phenomenal) |         |         |         |         |         |         |         |         |
|---|---------|---------|---------|---------|---------|---------|---------|---------|
|   | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 |
| Heave motion (m)                            | 3.56    | 3.49    | 3.50    | 3.75    | 3.56    | 3.57    | 3.50    | 3.75    |
| Pitch motion (deg)                          | 9.72    | 7.32    | 7.81    | 7.64    | 9.72    | 9.90    | 7.81    | 7.64    |
| Heave velocity (m/s)                        | 1.66    | 1.58    | 1.59    | 1.70    | 1.66    | 1.68    | 1.59    | 1.70    |
| Pitch velocity (rad/s)                      | 0.29    | 0.19    | 0.22    | 0.21    | 0.29    | 0.29    | 0.22    | 0.21    |
| Heave acceleration (m/s <sup>2</sup> )      | 1.41    | 1.14    | 1.19    | 1.25    | 1.41    | 1.44    | 1.19    | 1.25    |
| Pitch acceleration (rad/s <sup>2</sup> )    | 0.64    | 0.41    | 0.53    | 0.48    | 0.64    | 0.63    | 0.53    | 0.48    |

## 5. Conclusion

The evaluation of the cone capsule shaped hull forms was made. The design configurations were developed through the modifications of the cone capsule geometry parameters such as the radius of bilge, the height of the boat, and the radius of the top. It was determined for the tsunami lifeboats draught is 0.50m. The modifications may produce the hull form models that was used as an alternative hull form for the tsunami lifeboat

Based on the results of numerical analysis, it is indicated that the entire hull forms model was accepted by the IMO Criteria. However, the model 6 has shown a better intact stability performance than the other hull form models. The small radius of bilge and the large radius of the top may improve the intact stability performance for the cone capsule shaped hull form. In the case of seakeeping analysis, the model 2 shows the better seakeeping performance than the others. The minimum amplitude of the motions was obtained as 3.49m for heave motion and 7.32° for pitch motion on the phenomenal sea condition.

Although the numerical analyses have shown that the entire hull form models were reliable for the tsunami lifeboat on the intact stability and seakeeping performance, however, the experimental studies should be made as a requirement of the classification regulations for the development of a new lifeboat hull forms.

## References

- [1] BMKG 2012 *Pedoman pelayanan peringatan dini tsunami* (Indonesia: Pusat gempa bumi dan tsunami kedeputian bidang geofisika Badan Meteorologi Klimatologi dan Geofisika)
- [2] BMKG 2010 *Katalog Tsunami*
- [3] Schreck E, 2008 *Proc. 6th Int. Conf. on CFD in Oil & Gas (Trondheim)* p 1
- [4] Bae D M, Kim H S and Zakki A F 2009 *Proc. of the Ann. Aut. Meet. SNAK (Mungyeong)* p 929
- [5] Bae D M, Kim H S and Zakki A F 2009 *Proc. of the Ann. Aut. Meet. SNAK (Mungyeong)* p 938
- [6] Bae D M, Zakki A F, Kim H S, and Kim J G 2010 *J. Soc. Nav. Archit. Korea* **47** 681
- [7] Bae D M and Zakki A F 2011 *J. Soc. Nav. Archit. Korea* **48** 552
- [8] Luo H, Wang H, and Soares C G 2012 *Ocean Eng.* **40** 1
- [9] Aagaard O 2013 *Hydroelastic Analysis of Flexible Wedges* (NTNU)
- [10] Larsen E 2013 *Impact Loads on Circular Cylinders* (NTNU)
- [11] Shito M, Inuzuka I, Amaya I, Saito H, and Kurata J 2014 *IHI Eng. Rev.* **46** 21
- [12] Zakki A F, Windyandari A and Bae D M 2016 *J Mar Sci and Tech-Taiw* **24** 575
- [13] Prabowo A R, Bae D M, Sohn J M and Zakki A F 2016 *IJTech* **4** 592
- [14] Bae D M, Prabowo A R, Cao B, Zakki A F and Haryadi G D 2016 *J Mar Sci Appl* **15** 63
- [15] Crismianto D, Zakki A F, Adietya B A, Kim D. J. 2015 *J Mar Sci Appl* **14** 399

# iop tsunami lifeboat

## ORIGINALITY REPORT

23%

SIMILARITY INDEX

19%

INTERNET SOURCES

16%

PUBLICATIONS

7%

STUDENT PAPERS

## PRIMARY SOURCES

1

Submitted to Bond University

Student Paper

3%

2

[www.gitews.org](http://www.gitews.org)

Internet Source

2%

3

[en.wikipedia.org](http://en.wikipedia.org)

Internet Source

2%

4

[www.ijtech.eng.ui.ac.id](http://www.ijtech.eng.ui.ac.id)

Internet Source

1%

5

[ejournal.undip.ac.id](http://ejournal.undip.ac.id)

Internet Source

1%

6

Submitted to University of Birmingham

Student Paper

1%

7

[linknovate.com](http://linknovate.com)

Internet Source

1%

8

[trid.trb.org](http://trid.trb.org)

Internet Source

1%

9

[www.fe.ethz.ch](http://www.fe.ethz.ch)

Internet Source

1%

10

[www.naval-architect.com](http://www.naval-architect.com)

Internet Source

1 %

11

[journals.modares.ac.ir](http://journals.modares.ac.ir)

Internet Source

1 %

12

Das, . "Modeling Vehicle Systems", Mechatronic Modeling and Simulation Using Bond Graphs, 2009.

Publication

1 %

13

Tri Pujadi. "Early warning systems using dynamics system for social empowerment society environment", 2017 International Conference on Information Management and Technology (ICIMTech), 2017

Publication

1 %

14

D Chrismianto, Tuswan, P Manik. "Analysis Of Resistance And Effective Wake Friction Due To Addition Of Stern Tunnels On Passenger Ship Using Cfd", IOP Conference Series: Earth and Environmental Science, 2018

Publication

1 %

15

Chrismianto, Deddy, Ahmad Fauzan Zakki, Berlian Arswendo, and Dong Joon Kim. "Development of cubic bezier curve and curve-plane intersection method for parametric submarine hull form design to optimize hull resistance using CFD", Journal of Marine Science and Application, 2015.

1 %



- 
- |           |   |            |
|-----------|---|------------|
| <b>16</b> | <b>Submitted to Universitas Negeri Surabaya The State University of Surabaya</b><br>Student Paper | <b>1 %</b> |
|-----------|---|------------|
- 
- |           |  |                |
|-----------|--|----------------|
| <b>17</b> | <b>Submitted to (school name not available)</b><br>Student Paper | <b>&lt;1 %</b> |
|-----------|--|----------------|
- 
- |           |   |                |
|-----------|---|----------------|
| <b>18</b> | <b>Aditya Rio Prabowo, Dong Myung Bae, Jung Min Sohn, Bo Cao. "Energy behavior on side structure in event of ship collision subjected to external parameters", Heliyon, 2016</b><br>Publication | <b>&lt;1 %</b> |
|-----------|---|----------------|
- 
- |           |  |                |
|-----------|--|----------------|
| <b>19</b> | <b>A Juniansah, B I Tyas, G C Tama, K R Febriani, N M Farda. "Spatial modelling for tsunami evacuation route in Parangtritis Village", IOP Conference Series: Earth and Environmental Science, 2018</b><br>Publication | <b>&lt;1 %</b> |
|-----------|--|----------------|
- 
- |           |   |                |
|-----------|---|----------------|
| <b>20</b> | <b><a href="https://composite-indicators.jrc.ec.europa.eu">composite-indicators.jrc.ec.europa.eu</a></b><br>Internet Source | <b>&lt;1 %</b> |
|-----------|---|----------------|
- 
- |           |  |                |
|-----------|--|----------------|
| <b>21</b> | <b><a href="http://www.arbloc.com">www.arbloc.com</a></b><br>Internet Source | <b>&lt;1 %</b> |
|-----------|--|----------------|
- 
- |           |  |                |
|-----------|--|----------------|
| <b>22</b> | <b><a href="http://pertambangan.fst.uinjkt.ac.id">pertambangan.fst.uinjkt.ac.id</a></b><br>Internet Source | <b>&lt;1 %</b> |
|-----------|--|----------------|
- 
- |           |  |                |
|-----------|--|----------------|
| <b>23</b> | <b>Submitted to South Dakota Board of Regents</b><br>Student Paper | <b>&lt;1 %</b> |
|-----------|--|----------------|
-

- |    |  |      |
|----|--|------|
| 24 | Mørch, Hans Jørgen, Milovan Perić, Eberhard Schreck, Ould el Moctar, and Tobias Zorn. "Simulation of Flow and Motion of Lifeboats", Volume 5 Polar and Arctic Sciences and Technology CFD and VIV, 2009.<br>Publication  | <1 % |
| 25 | Zakki Ahmad Fauzan, Aris Triwiyatno, Bandi Sasmito, Muhammad H. Nubly. "Intact stability and seakeeping characteristics of autonomous surface vehicle (asv) using swath hullform to support bathymetry survey activities on the coastal area", MATEC Web of Conferences, 2018<br>Publication | <1 % |
| 26 | <a href="http://libra.acadiau.ca">libra.acadiau.ca</a><br>Internet Source  | <1 % |
| 27 | <a href="http://link.springer.com">link.springer.com</a><br>Internet Source  | <1 % |
| 28 | <a href="http://orbi.uliege.be">orbi.uliege.be</a><br>Internet Source  | <1 % |
| 29 | <a href="http://tel.archives-ouvertes.fr">tel.archives-ouvertes.fr</a><br>Internet Source  | <1 % |
| 30 | Anisya, Ganda Yoga Swara. "Implementation Of Haversine Formula And Best First Search Method In Searching Of Tsunami Evacuation Route", IOP Conference Series: Earth and  | <1 % |

31

ediss.uni-goettingen.de

Internet Source

<1 %

32

"Accidental Injury", Springer Nature America, Inc, 1993

Publication

<1 %

33

Y Yunarto, A M Sari. "Analysis of community tsunami evacuation time: An overview", IOP Conference Series: Earth and Environmental Science, 2018

Publication

<1 %

34

Yosritzal, B M Kemal, Purnawan, H Putra. "An observation of the walking speed of evacuees during a simulated tsunami evacuation in Padang, Indonesia", IOP Conference Series: Earth and Environmental Science, 2018

Publication

<1 %

35

Bae, Dong-Myung, Aditya Rio Prabowo, Bo Cao, Ahmad Fauzan Zakki, and Gunawan Dwi Haryadi. "Study on collision between two ships using selected parameters in collision simulation", Journal of Marine Science and Application, 2016.

Publication

<1 %

36

A Fakhurrozi, A M Sari. "Spatial Analysis of Traffic and Routing Path Methods for Tsunami

<1 %

# Evacuation", IOP Conference Series: Earth and Environmental Science, 2018

Publication

---

---

Exclude quotes      Off

Exclude matches      Off

Exclude bibliography      On